Center Independent Research & Development: LaRC IRAD

Silicon Germanium Quantum Well Solar Cell

Completed Technology Project (2013 - 2014)

Project Introduction

A single crystal SiGe has enormous potentials for high performance chips and solar cells. This project seeks to fabricate a rudimentary but 1st cut quantum-well photovoltaic (PV) cell and assess/demonstrate PV function.

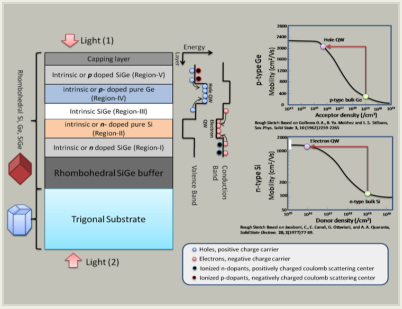
Quantum-well structures embodied on single crystal silicon germanium drastically enhanced carrier mobilities. The cell-to-cell circuits of quantum-well PV cells are laid out at the bottom of epitaxial layers, unlike the circuits laying out at the top of the conventional PV cells which cut off the incident solar flux up to 15% level. Since the circuit layout is built at the bottom of PV array, the circuits are densely laid out to reduce the internal resistance substantially. Again since silicon germanium compound has much broader bandgap structure than silicon alone, it can utilize more solar energy to free up valence band electrons. Structurally, the sapphire substrate surface of quantum-well PV cells is very strong and does not require any special protective coatings and frames to hold them. Therefore, the anticipated life of quantum-well PV cells is more than ten-times longer than Si PV cells. Summing up these advantages of quatum-well PV cells, the overall conversion efficiency would reach well beyond 35% and the energy density would be tripled as compared to the conventional PV cells. The overall cost factor would be 5 cents per kWh competitively.

Anticipated Benefits

Satellites and space exploration applications

Airship power source, field terrestrial applications for power collection

Satellite power system.



Project Image Silicon Germanium Quantum Well Solar Cell

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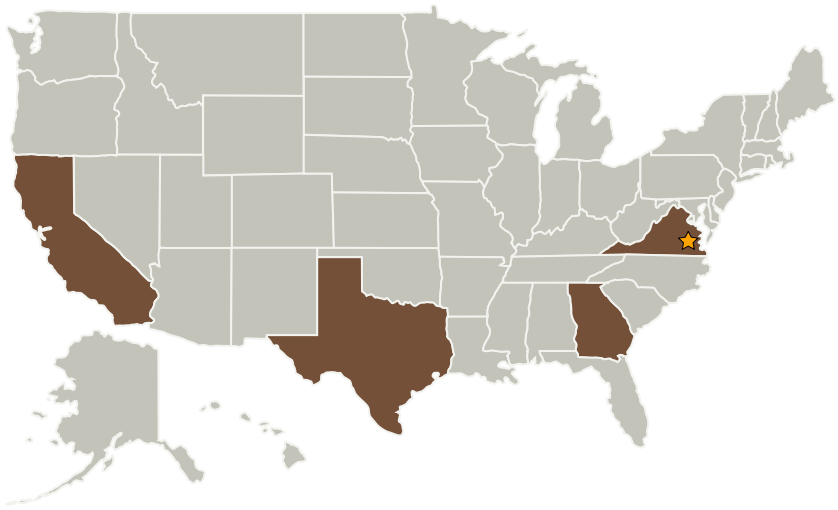
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia

Co-Funding Partners	Type	Location
Georgia Institute of Technology-Main Campus(GA Tech)	Academia	Atlanta, Georgia
innoEpi Inc.	Industry	
Norfolk State University(NSU)	Academia	Norfolk, Virginia
University of Houston	Academia	Houston, Texas

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Center Independent Research & Development: LaRC IRAD

Project Management

Program Manager:

Julie A Williams-byrd

Project Manager:

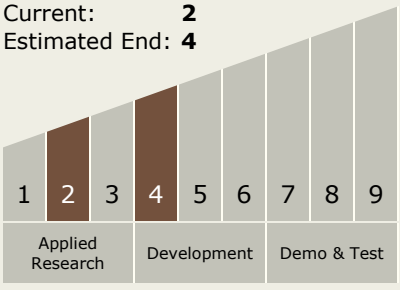
Glen C King

Principal Investigator:

Glen C King

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **4**



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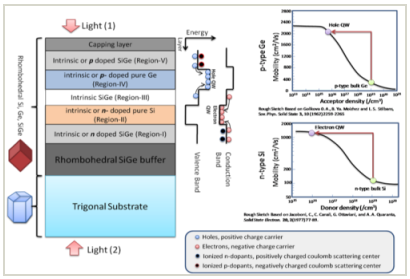
Primary U.S. Work Locations	
California	Georgia
Texas	Virginia

Images



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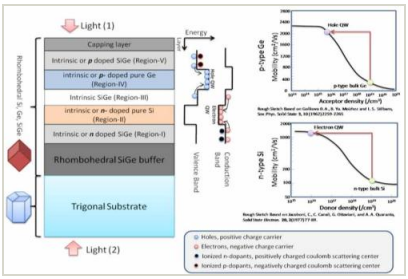
Project Image Silicon Germanium Quantum Well Solar Cell
(https://techport.nasa.gov/image/2285)



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Project Image Silicon Germanium Quantum Well Solar Cell
(https://techport.nasa.gov/image/2286)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.1 Photovoltaic